Funding liquidity risk and financial stability: evidence from cooperative banks

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Abstract

In 2010 the Basel Committee on Banking Supervision (BCBS) introduced new liquidity rules phased in under Basel III and, specifically, defined the Net Stable Funding Ratio (NSFR) with the aim of making the financial system more stable and resilient. The aim of this analysis is to examine the relationship between the NSFR and banks' stability with a particular focus on cooperative industry. Based on a panel dataset of 1,173 cooperative banks from Austria, Germany and Italy, observed over the years 2011-2018, I find that stability improves for cooperative banks that have higher NSFRs, but there is a point at which increasing further the NSFR diminishes their stability. The marginal impact of the NSFR on cooperative banks' stability increases as the banks efficiency increases, and diminishes as the income diversification and the size increase. Results remain robust after some robustness tests.

JEL classification: G21; G28
Keywords: Cooperative Banks; Financial Stability; Funding Liquidity Risk; Net Stable Funding Ratio

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1. Introduction

Cooperative banks play a pivotal role in the financial systems of many countries, mainly providing a crucial support to local economic development. They account for about 20% of the market of European Union (EU) bank deposits and loans (4,153,902 million Euro and 4,559,612 million Euro in 2019, respectively). According to the European Association of Cooperative Banks (EACB), in 2020, the 2,700 locally operating banks in the EU had 85 million members, which means that 1 out 5 European citizens is member of a cooperative bank, served 214 million customers, and employed 705,000 people (EACB, 2020). Cooperative banks are the main credit providers to household citizens in terms of mortgage credit and consumer credit and one of the largest lenders to small and medium enterprises (SMEs), in both good and bad times, as shown during the financial turmoil (Meriläinen, 2016). Because of their specific commitment to owners, customers and local development, the majority of European cooperative banks are small- and medium-sized institutions that are considered as "Less Significant Institutions" (LSIs) from a regulatory perspective (ECB, 2016). Within the Euro Area, 80% of the LSIs are concentrated in the three countries Austria, Germany and Italy, the majority being cooperative banks (Mare and Gramlich, 2021).

Maturity transformation is a key function of cooperative banks. They are typically called to transfer funds from agents in surplus demanding short-term deposits to agents in deficit with long-term financing needs. The consequent maturity mismatch between assets and liabilities should allow banks to earn a spread in ordinary conditions, but at the same time makes them exposed to the funding liquidity risk related to the need to roll-over short-term liabilities. Even if banks are generally advised to maintain a liquidity buffer for managing liquidity risk and to insure against liquidity shocks, the 2007-2009 Global Financial Crisis (GFC) highlighted fundamental weaknesses in the way banks used to manage their liquidity positions and their exposure to both market and funding liquidity risk. There is wide agreement that insufficient liquidity buffers were a root cause of crisis and the on-going disruptions of the world financial system, making the improvement of liquidity risk analysis and supervision a key issue for the years to come. Just in response to the GFC, the Basel Committee on Banking Supervision (BCBS) issued stronger liquidity requirements through a set of reforms commonly known as Basel III. Specifically, the BCBS introduced two new regulatory measures in the Basel III framework: the Liquidity Coverage Ratio (LCR), which focuses on the short-term (30 days) liquidity position, and the Net Stable Funding Ratio (NSFR), which aims to monitor the long-term funding stability.

As the Basel III adoption is being phased in, the full impact of these new regulatory requirements on the banking industry is relatively unknown and it is uncertain whether they will make banks less risky and the whole financial system more stable. There is very little theoretical or empirical research

on the impact of minimum liquidity standards on bank liquidity risk or other bank risk-taking behaviours (De Young and Jang, 2015), and the few extant studies focus on commercial banks, because the regulatory framework is generally designed with commercial banks in mind. To the best of my knowledge, the impact of the new liquidity requirements on the stability of the cooperative banking industry has never been investigated by prior researches. Nevertheless, I expect liquidity rules to have a tremendous influence on cooperative banks' performance and stability because a more intense maturity transformation and a lower recourse to financial derivatives make their asset-liability management more constrained relative to larger, non-cooperative credit institutions. Therefore, better understanding the potential relation between cooperative banks' funding liquidity risk and their risk-taking behaviour is of paramount importance and allows studying a sector that has not yet received appropriate attention in the empirical banking literature.

The objective of this paper is to investigate the relationship between the NSFR and cooperative banks' stability. In providing this evidence, I contribute to different fields of the economic and finance literature. First, to the best of my knowledge, this is the first study about the effect of this new liquidity requirement on financial stability entirely conducted on cooperative banks from European countries. This allows me to add new insight on the liquidity-stability relationship by focusing on banks characterized by a different business model if compared with commercial banks, for which the impact of liquidity risk on stability has already been examined by previous studies. Second, compared with cooperative banking literature, that exclusively analyses the effects of capital requirements on cooperative banks' stability, I estimate the impact of the NSFR on cooperative banks' stability and risk-taking aptitude. Third, relative to prior literature, which mainly uses liquidity measures built by considering only one side of the bank balance-sheet (Acharya and Naqvi, 2012; Khan et al., 2017), I study how cooperative banks' stability reacts to the new prudential limit on their structural funding risk using a proxy for the NSFR. This allows to have a more comprehensive view of a bank's asset and liability structure and effective liquidity position.

The analysis is referred to a large panel dataset of 1,173 cooperative banks from Austria, Germany and Italy observed during the years 2011-2018 and main findings can be summed up as follows. With regard to the test on the impact of the NSFR on banks' stability, bank risk has been measured in many different ways in the literature. This research focuses specifically on the overall bank riskiness, through the Z-score, a measure of their distance to default widely used in banking studies. The empirical findings suggest a non-linear relationship between liquidity and stability: stability improves for cooperative banks that have higher NSFRs, but there is a point at which a further increase in the NSFR diminishes their stability. By specifically taking banks' characteristics into account, the

evidence shows that the marginal impact of the NSFR on cooperative banks' stability increases as the efficiency increases, and diminishes as both income diversification and size increase.

I believe these findings to be relevant in many aspects. Analysing the effect of the NSFR on cooperative banks' stability is of special interest to several stakeholders, such as customers-members and local community, due to the support that cooperative banks grant to SMEs and private citizens, by offering competitive banking products adjusted to better account local conditions. Futhermore, I add evidence to prior research investigating whether and to what extent banks' stability and risk-taking aptitude changes in response to the NSFR introduction, which is a relevant issue from both bank managers' and regulators' perspective.

The remainder of the paper is organised as follows. Section 2 presents a review of the main contributions from the related, previous literature and discusses the objective of the research that I aim to achieve through the empirical part of the paper. Section 3 describes the sample and presents the variables of interest and the controls used in the empirical analysis. Section 4 discusses the empirical methodology. Sections 5 and 6 present the empirical results and the robustness tests. Section 7 concludes and discusses some policy implications.

2. Literature review and research objective

This paper contributes to two main streams of empirical banking research. The former is related to cooperative banks' stability and risk-taking aptitude. The latter refers to the impact of the Basel III regulatory reform regarding capital and liquidity standards on the banking sector. In particular, studies on the impact of capital requirements are conducted on both commercial and cooperative banks, whereas analyses on the effects of liquidity requirements only consider commercial banks.

2.1 Literature on cooperative banks' stability

As far as the stability-realated studies, whether cooperative banks are more or less stable than commercial banks is a largely debated issue. Financial cooperatives have different risk-taking incentives if compared with commercial banks, since they pursue social and economic development objectives rather than shareholder value maximization. Given a stable deposit base and business strategies that aim to build up capital for future generations, financial cooperatives may be less fragile than commercial banks. However, financial cooperatives are less diversified and have less option to raise capital at short notice (McKillop et al., 2020). Consequently, financial cooperatives are less able to absorb demand-or supply-side shocks to their balance sheets (Fonteyne, 2007). Results from extant empirical studies suggest opposite views.

On one hand, literature appears to suggest that savings banks and financial cooperatives are less risky than commercial banks. For banks from OECD countries, Hesse and Cihák (2007) find that cooperative banks are more stable than commercial banks due to the lower volatility of their returns, which more than offsets their lower profitability and capitalization. This is most likely due to cooperative banks' ability to use customer surplus as a cushion in weaker periods. As well Ayadi et al. (2010) provide empirical evidence that cooperative banks are more stable than commercial banks, because they have a great deal of soft information (which is hard to collect) on the creditworthiness of members/customers and are therefore less likely to make lending mistakes. Finally, Chiaramonte et al. (2015) detect that European cooperative banks are more stable than commercial banks during stressed periods, whereas the opposite appears to be true under normal economic conditions.

Conversely, several studies suggest that cooperative banks are more fragile than commercial banks (Brunner et al., 2004; Goodhart, 2004; Fonteyne, 2007) and have higher default rates. Fiordelisi and Mare (2013) document that the default rate of Italian cooperative banks was four times higher than that of commercial banks in the period before the financial crisis (1997-2006). For Japanese banks, Liu and Wilson (2013) show that risk varies across different types of banks over the period 2000-2009. Specifically, nationwide (City and Trust) banks are riskier on average than their counterparts (Regional, Tier 2 Regional, Shinkin and Credit Cooperative banks) with a regional focus. Nevertheless, they find that, when exposed to increasing competition, Japanese financial cooperatives become riskier than commercial banks. In the US, Goddard et al. (2008) present evidence that revenue diversification does not reduce risk or enhance the performance of credit unions, and Ely (2014) provides evidence that credit unions with broader field-of-membership are less well capitalized and exhibit greater earnings volatility. For Australia, Esho et al. (2005) detect that the increased reliance on fee-income generating activities is associated with increased risk.

2.2 Literature on the impact of Basel III reform

The recent Basel III reform has included revised capital and liquidity requirements. Capital ratios have long been a valuable regulatory tool for assessing the safety and soundness of both cooperative and commercial banks. Specifically, for cooperative banks, the Basel III regulatory aspect that has come under most academic scrutiny is capital requirements. This is particularly so for credit unions which in most countries do not have the option to raise new capital in the form of equity and so are more likely to manage their capital cautiously over the course of the business cycle. For US credit unions, Pana and Mukherjee (2010) find that higher levels of capital reduce their ability to create liquidity. Smith and Woodbury (2010) provide empirical evidence that credit unions are less sensitive to the business cycle than banks and should therefore be subject to lower capital requirements.

Goddard et al. (2016) detect that capital buffers for credit unions vary pro-cyclically and until the financial crisis, credit unions classified as adequately capitalized or below followed a faster adjustment path than well-capitalized ones. This pattern reversed in the aftermath of the crisis. Hessou and Lai (2017, 2018) provide evidence that Canadian credit union capital buffers behave counter cyclically and that they hold a capital buffer bigger than the maximum buffer advocated under Basel III. They also note that both the risk-based capital buffer and the leverage buffer are positively related to changes in loans and loan growth which underscores the importance of the Basel III conservation and the countercyclical buffer requirements in fostering credit. Hillier et al. (2008) find that capital adequacy regulations on Australian credit unions resulted in the use of accounting window dressing techniques to increase capital adequacy.

Also previous studies on commercial banks, estimating the relationship between regulatory requirements and the probability of a banking crisis, point to a clear role for capital. Increasing capital ratios, without any increase in liquidity, decreases banks' risk-taking and the likelihood of a systemic crisis (Barrell et al., 2009; Kato et al., 2010; Wong et al., 2010; Tarashev and Zhu, 2008; Miles et al., 2011; Gauthier et al., 2010). Instead, the impact of liquidity is addressed by far fewer models, even though liquidity has been shown to be just as important as capital for maintaining the stability of banking systems. To the best of my knowledge, empirical work on the connection between Basel III liquidity requirements and cooperative banks does not exist yet, and analysis on the effect of liquidity standards and commercial banks' subsequent probability of failure is still developing. The literature on liquidity risk and bank failures of commercial banks dates back at least to the seminal work of Diamond and Dybvig (1983) on systematic liquidity risk and bank runs.

However, few empirical studies have directly linked bank failures to funding liquidity risk. Yan et al. (2012) provide evidence that the Basel III reforms have a significant net positive long-term effect on the United Kingdom economy. The study finds that higher regulatory capital requirements not only reduce the probability of a banking crisis, but also reduce the economic loss from a banking crisis. King (2013) suggests that the implementation of the NSFR has adverse consequences for the economy due to the shrinking of banks' balance sheets, changes in the composition of assets or maturity thereof. Chalermchatvichien et al. (2014) suggest that an improvement in capital stability diminishes the extent of risk-taking. Hong et al. (2014) find that systemic liquidity risk is a major contributor to bank failures in 2009 and 2010, while both the NSFR and the LCR have limited effects on bank failures. Vazquez and Federico (2015) detect that higher funding stability, as measured by the NSFR featured in the new Basel III guidelines, reduces the probability of bank failures. Ashraf at al. (2016) provide empirical evidence that the modified NSFR has a positive impact on the financial stability of Islamic banks during the sample period (2000-2013). Khan et al. (2017) find evidence that

banks having lower funding liquidity risk, as proxied by higher deposit ratios, take more risk. Chiaramonte and Casu (2017) detect that the likelihood of failure and distress decreases with increased liquidity holdings, while capital ratios are significant only for large banks.

2.3 Research objective

This review of the literature demonstrates that empirical work on the connection between Basel III funding liquidity risk standard and banks' stability is still developing for commercial banks, whereas it does not exist for cooperative institutions. Building on the existing literature, I want to fill the gap and investigate the relationship between the NSFR and banks' stability with a particular focus on cooperative banking industry. It has been recognised that liquidity risk and credit risk do not have contemporaneous or causal relations, but both risks individually and jointly contribute to banks' probability of default (Imbierowicz and Rauch, 2014). Consistent with this view, King (2013) recognises that to maintain a higher NSFR, banks have to pay higher interest expenses for borrowing more long-term funds. In this way, liquidity regulation can adversely affect bank profitability and increase bank risk despite the associated public sector gains from the reduction in disruptive bank failures across the society. Similarly, Khan et al. (2017) find that a reduction in banks' funding liquidity risk increases bank risk, as evidenced by higher risk-weighted assets, greater liquidity creation and lower Z-scores.

The introduction of the NSFR produces incentives to collect longer-term and more stable sources of funds and/or to invest in more liquid and shorter-term assets, with a presumably negative impact on bank net interest margins (NIMs). *Ceteris paribus*, the negative effect of the NSFR on NIM could have also a negative impact on banks' stability due to lower retained earnings. Considering only cooperative banks, which have a stakeholders-oriented business model, I suppose that they tend to have less propensity to take risks than commercial banks. In fact, pressure from institutional investors and shareholders obsessed with wealth maximization might contribute to managers' excessive risk-taking, which could lead to financial instability and real economy fragility. Hence, on the basis of above considerations I suppose that cooperative banks facing lower funding liquidity risk (higher NSFR) become more stable and I test this hypothesis in the empirical part of this research.

3. Data and variables

3.1 Data

I study 1,173 cooperative banks operating in Austria, Germany, and Italy over the years 2011-2018. I focus only on these three countries, because they represent 80% of the LSIs in the Euro Area

(Mare and Gramlich, 2021). It is therefore paramount to describe how the NSFR affects cooperative banking systems' stability in these three countries. The frequency of the data is annual and the analysis is conducted on individual basis. Data are taken from several sources. I collect data of the dependent variable and the bank-specific explanatory variables from the Moody's Analytics BankFocus database, and macroeconomic data are taken from the World Bank database.

In contrast to the literature, which usually examines commercial banks, I include only cooperative banks. I believe this to be important for the broader applicability of the results, since cooperative institutions represent the majority of banks in the EU. I also think that the sample should better allow to identify the effects of banks' business models on bank stability, since cooperative banks are typically smaller and have a different business model than commercial banks. Not only do cooperative banks have a business model which is different from that of commercial banks, they also differ from commercial banks in terms of their business objective and ownership structure (Čihák and Hesse, 2007; Beck et al., 2009). While commercial banks are owned by their shareholders and aim at maximizing profits, cooperative banks are owned by their stakeholders and are created primarily to provide financial services to specific sectors or to improve financial access in selected geographical areas. This suggests that cooperative banks may have a different risk-taking behaviour.

The overall Moody's Analytics BankFocus datasample has been filtered using three criteria. First, I limit the analysis to cooperative banks active in the EU for the entire sample period. Second, I focus on Austria, Germany, and Italy, because they represent by far the majority of cooperatives in the EU. Third, to avoid duplication, I consider consolidated data where possible and unconsolidated data otherwise. Finally, I winsorize the data at the 1st and 99th percentile level to ensure that outliers do not bias estimates, and, to ensure a sufficiently long presence in the database, I select only banks that have minimum four years of consecutive observations. The final database consists of an unbalanced panel of cooperative banks consolidated data and a total of 7,531 observations, 25% of which refer to the Austrian banking system, 56% to the German one, and 19% to the Italian cooperatives.

3.2 Measuring banks' stability: the Z-score

The Z-score has been widely used in the risk-taking literature to measure individual bank financial stability and failure probability (Laeven and Levine, 2009; Demirgüç-Kunt and Huizinga, 2010; Ashraf et al., 2016; Khan et al., 2017). The Z-score methodology combines profitability, leverage, and return volatility in a single measure and explicitly compares bank buffers (shareholders' equity and earnings) with its operating risk (volatility of earnings) (Berger et al., 2009; Pham, 2016).

Mathematically, it measures the number of standard deviations of a bank's return-on-assets it would have to fall to deplete the sum of its equity and income. Z-score has advantages over other

accounting-based financial stability measures due to its capability to capture both interest and fee-based income streams. Following Laeven and Levine (2009), Z-score is calculated as:

$$Z - score_{it} = \frac{ROA_{it} + CAR_{it}}{\sigma(ROA)_{ip}} \quad (1)$$

where ROA_{it} is the return on assets and CAR_{it} is the equity capital-to-asset ratio, with subscripts *i* and *t* referring to bank *i* and time *t*, respectively. $\sigma(ROA)_{ip}$ is the volatility of return-on-assets of bank *i*, calculated over the sample period *p*. A higher (lower) Z-score implies a lower (higher) probability of insolvency and therefore higher (lower) bank stability (Andries et al., 2016). After computing the Z-score, I find that the distribution is highly skewed. In order to reduce this asymmetry, I use its logarithmic transformation in all empirical estimations, which is normally distributed, to smooth out higher values (Laeven and Levine, 2009; Houston et al., 2010; Schaeck and Čihák, 2012). For brevity, I use the label "Z-score" when referring to the natural logarithm of the Z-score in the rest of the paper.

3.3 Measuring funding liquidity risk: the NSFR

The relation between funding liquidity risk, on one hand, and stability and risk-taking aptitude, on the other, has already been investigated by prior banking literature. Acharya and Naqvi (2012) and Khan et al. (2017) use the ratio of total deposits to total assets as proxy for banks' funding liquidity risk, arguing that excessive deposits will induce bank managers to take more risk, because banks with more deposits are less likely to face a funding crisis in the near term. Therefore, a decrease in the funding liquidity risk increases banks' risk-taking. Compared to these studies, I use a new specific measure of funding liquidity risk: a proxy for the Basel III NSFR standard.

In December 2010 the BCBS set the introduction of liquidity standards for banks in the so-called Basel III accord. In particular, the BCBS developed two quantitative measures for liquidity: the Liquidity Coverage Ratio (LCR), which aims to ensure that banks have enough liquid assets to withstand liquidity stress in the short term, and the Net Stable Funding Ratio (NSFR), which aims to encourage banks to hold more stable and longer term funding sources against their liquid assets, thereby reducing maturity transformation risk. The two liquidity ratios are required to be above 100%. The Basel III liquidity standards have undergone substantial revisions since they were first issued in December 2010. With respect to the NSFR, the overall aim of these changes was to ensure that the indicator reflected a bank's structural liquidity risk rather than it being calculated for stress testing purposes only. These changes include greater differentiation in terms of maturity, to allow for the prompt identification of banks with excessive maturity mismatches and more fragile funding

structures (BCBS, 2014). In October 2014, the BCBS issued the final standard for the NSFR, which became a minimum standard on 1 January 2018. More specifically, the NSFR is the ratio between the amount of Available Stable Funding (ASF) relative to the amount of Required Stable Funding (RSF):

$$\text{NSFR} = \frac{\text{ASF (Available Amount of Stable Funding)}}{\text{RSF (Required Amount of Stable Funding)}} \geq 100\% \quad (2)$$

where: the ASF comprises weighted liabilities reflecting their contractual maturity and is defined as the portion of capital and liabilities expected to be a reliable source of funding over a one-year time horizon; the RSF of a specific bank is a function of the liquidity characteristics and residual maturities of the various assets held by that institution as well as those of its off-balance sheet exposures (BCBS, 2014). The ASF and RSF are calibrated to reflect the presumed degree of stability of a bank's liabilities and liquidity of a bank's assets. The weights for assets and liabilities range from 0% to 100%; these are primarily the result of internationally agreed definitions and calibrations.

To estimate the sample banks' NSFRs, I have to address one main issue: to apply the appropriate ASF and RSF weighting factors in the presence of limited information, since I construct NSFR estimates by using banks' financial statements available from the Moody's Analytics BankFocus database. BCBS (2014) established the components of each of the ASF categories and the associated maximum ASF weighting factor to be applied in calculating an institution's total amount of available stable funding, and the specific types of assets to be assigned to each asset category and their associated RSF weighting factor to obtain the total amount of required stable funding. To calculate my measure of the NSFR, I follow Scalia et al. (2013), who make some simplifying assumptions concerning the weighting scheme, based on IMF (2011). The choice of the factors for each item of the available data is detailed in Table 1, together with the variation range of the regulatory weights, applicable to the granular sub-items.

[Insert Table 1 here]

The adoption of the NSFR is likely to decrease bank riskiness by making the structure of the maturity mismatches between assets and liabilities more balanced. Since this should lead to an increase in bank stability, I expect a positive sign of the related coefficient.

3.4 Other determinants of banks' stability

As to banks' characteristics, I specifically control for performance-related variables (non-interest income, efficiency, and credit risk), banks' business model (loans and deposits) and size.

A cooperative bank's stability is function of its income sources. Income sources for banks have changed considerably over the past couple of decades. Busch and Kick (2009) conclude that fee income is more stable for commercial banks in Germany from 1995 to 2007. However, income diversification has been identified as one of the major factors that may contribute to the fragility of banks (Demirgüç-Kunt and Huizinga, 2010; Ashraf and Goddard, 2012; Köhler, 2014; Ashraf et al., 2016). NII is the ratio of non-interest income and operating income, and a positive sign of its coefficient would imply a higher stability due to diversification benefits. Following Ashraf et al. (2016), I use the inverse of the cost-to-income ratio (EFF) to control for efficiency. I expect a positive coefficient for this variable, since higher efficiency helps cooperative banks to become more stable. I estimate credit risk with the ratio of loan loss provisions to customer loans (CR). The higher the ratio, the lower the credit quality and bank stability. Therefore, a negative coefficient is expected.

Following Khan et al. (2017), I control for the business model using the ratio of customer loans to total assets (LOAN) and the ratio of customer deposits and total assets (DEP). A better quality of loans is associated to a more stable bank. I expect a positive relationship between loans and bank stability in the case of banks issuing high-quality loans, and a negative coefficient otherwise. Relative to wholesale funds, customer deposits reprice more slowly and are more stable, not least because they are protected by deposit insurance (Shleifer and Vishny, 2010), which makes their withdrawals usually predictable at the aggregate level (Song and Thakor, 2007; Huang and Ratnovski, 2011). This suggests that banks with a larger share of customer deposits and, *ceteris paribus*, a lower share of wholesale funds may be less risky. On the other hand, from a stability perspective, banks can take advantage of two benefits associated with a larger recourse to market financing relative to customer deposits: a higher market discipline, exerted by relatively sophisticated financial market investors (Calomiris and Kahn, 1991); a higher flexibility of non-deposit funding in adapting to changes in financing needs to fund investment opportunities. Therefore, based on this arguments, a negative sign of the DEP variable might also be found.

The size of the bank significantly influences the assets composition and ultimately its risk-taking behaviour (Schwerter, 2011). Furthermore, larger banks can maintain higher liquidity levels due to easier access to financial market funds and to the safety net of the "lender of last resort" (Distinguin et al., 2013). Similarly, larger banks enjoy better franchise value and can use diversification as a tool for risk management (Demsetz and Strahan, 1997). I measure size as the natural logarithm of total assets (SIZE). A negative coefficient would support the "too-big-to-fail" phenomenon, while a positive coefficient would reflect the impact of higher franchise value, better risk management systems, and easier access to the "lender of last resort" (Ashraf et al., 2016).

The level of concentration within the banking sector and the economic outlook of a country play an important role in determining bank stability. I include the Herfindahl-Hirschman index (HHI) and the annual percentage change of gross domestic product (GDPGR), respectively, to measure them. The HHI is the sum of the squared market share value (in term of total assets) of all banks in the country (CONC). Prior research shows conflicting evidence about the relation between market concentration and banks' stability. Vives (2011) argues that there are two possible ways in which higher levels of competition (lower concentration) can lead to banking instability. Firstly, by aggravating the coordination problem of depositors/investors on the liability side and fostering runs/panics. Second, by increasing incentives to engage in high risk activity ultimately results in an increased probability of failure. More specifically, Carletti (2008) and Beck et al. (2013) find a negative relationship between concentration and stability by focusing on the liability side of bank balance-sheet, whereas, based on the loan market analysis and risk-taking argument, Boyd and De Nicolò (2005) suggest a positive link. Banks from countries with a higher level of economic development are supposed to be more stable. A higher rate of GDP growth is associated with a more stable macroeconomic environment and a relatively lower likelihood of bank failure and distress (Betz et al., 2014; Köhler, 2014; Khan et al., 2017; Chiaramonte and Casu, 2017). Hence, the hypothesis is that GDPGR positively affects cooperative banks' stability.

Table 2 reports the variables used in the empirical investigation. For each of them, the table shows a brief description and the data sources; for the independent variables, the table also reports the expected sign of their relation with the Z-score.

[Insert Table 2 here]

3.5 Descriptive statistics

Table 3 reports the descriptive statistics for the variables included in the regression model. For each variable, the total number of available observations, the mean, the standard deviation, the median, the minimum and the maximum values are shown. Sample banks have an average NSFR of 1.03 over the entire investigation period, which means that, overall, cooperative banks meet the minimum liquidity requirement established by the Basel III framework. As expected, since cooperative banks are involved in the traditional activity of collecting deposits from and issuing loans to customers, the former account for 73.53% of their total funds and the latter are 60.68% of total assets, and non-interest income is just 33.37% of total operating income.

[Insert Table 3 here]

Based on the overall evidence reported in Table 4, the low pair-wise correlation coefficients among variables suggests that the empirical analysis is not influenced by multi-collinarity issues.

[Insert Table 4 here]

4. Empirical methodology

Following Bordeleau and Graham (2010), I estimate a regression model where banks' stability is regressed against a non-linear expression of the NSFR, as well as a set of bank-specific and country-specific variables. The baseline model developed to test the impact of funding liquidity risk (the NSFR) on cooperarive banks' stability is:

$$Y_{ict} = c + \beta_1 NSFR_{ict} + \beta_2 NSFR_{ict}^2 + \beta_3 NII_{ict} + \beta_4 EFF_{ict} + \beta_5 CR_{ict} + \beta_6 LOAN + \beta_7 DEP_{ict} + \beta_8 SIZE_{ict} + \beta_9 CONC_{ct} + \beta_{10} GDPGR_{ct} + \varepsilon_{it} \qquad \varepsilon_{it} = v_i + u_{it} \tag{3}$$

where Y_{ict} is the stability indicator, i.e. the Z-score, calculated using Eq. (1); $NSFR_{ict}$ is the Net Stable Funding Ratio, calculated using Eq. (2); $NSFR_{ict}^2$ is the NSFR squared, with i = 1,…., N, c = 1,…., M and t = 1,…., T; c is a constant term; and ε_{it} is the error term, with v_i being the bank-specific component and u_{it} the idiosyncratic factor. Then I include bank- and country-specific controls.

In line with previous studies (Köhler, 2014), I analyse the economic causality using panel fixed-effects technique to capture the influence of each bank specific variable. Apart from the results of the Hausman test, the choice for fixed instead of random effect model has two main reasons. First, if the individual effect represents omitted variables, it is highly likely that these bank-specific characteristics are correlated with the other regressors and therefore fixed effects estimation helps to partially eliminate endogeneity problems. Second, I want to analyse the adjustments of banks' behaviour in the time variation and not in the cross-sectional variation of the data.

5. Results

The regression analysis proceeds as follows and its results are shown in Table 5 and 6. I first estimate the regression model presented in Eq. (3), which I define baseline model, on the whole sample period (2011-2018) (column 1 of Table 5). During the last decade, in response to the 2007 world-wide financial crisis and to the 2010 European sovereign debt crisis, ECB adopted ultra-

expansionary monetary measures that drove interest rates to historically low levels and led to a flattening of the yield curve, which has risen concern for an erosion of banks' profits. Recently, to complement and reinforce existing measures, the Euro Area monetary authority started in June 2014 the so-called negative interest rates policy (NIRP) to provide additional support (Arteta et al. 2018). Therefore, I decide to split the entire 2011-2018 sample period in two sub-periods (2011-2014 vs. 2015-2018) to detect the relation between the NSFR and cooperative banks' stability under different interest rates scenarios, separately. Results of the baseline model referred to the years 2011-2014 are reported in column 2 of Table 5, and those of the years 2015-2018 in column 3 of Table 5. In the second step, in order to test the joint effect of the NSFR and other important characteristics of cooperative banks on their stability, I re-estimate the model adding a set of specific interaction terms (Table 6).

In Table 5, findings indicate that the NSFR is an important determinant of cooperative banks' stability: the adoption of this requirement is likely to increase their stability by making the structure of the maturity mismatches between assets and liabilities more balanced. Though none of prior studies examines the funding liquidity risk-stability relation for cooperative banks, my results are in line with the evidence of Chalermchatvichien et al. (2014) and Ashraf et al. (2016), which both suggest that more stable funding reduces the extent of bank risk-taking, but in contrast with Khan et al. (2017), according to which a decrease in banks' exposure to funding liquidity risk increases their risk-taking aptitude. In addition, as Bordeleau and Graham (2010), I find evidence of a non-linear relationship between the NSFR and cooperative banks' stability. More specifically, the negative coefficient on NSFR2 indicates that their stability is maximized at a certain NSFR*, after which it starts to decline, drawing a downward-concave parabola.

The significantly positive coefficient of non-interest income (NII) shows that cooperative banks are less risky (in the sense of having a higher Z-score) if they increase their share of non-interest income, which suggests that substantial benefits are to be gained from income diversification. Cooperative banks' efficiency (EFF) positively affects their stability, which is consistent with what shown by Ashraf et al. (2016) for Islamic banks. In line with expectations, banks exposed to higher credit risk are less stable: the coefficient of the ratio of loan loss provisions to customer loans (CR) is negative and statistically significant.

As far as the two business model-related variables used to control for banks' asset and funding mix, the coefficient of the share of loans on total assets (LOAN) is significantly positive, while that of the ratio of customer deposits on total funds (DEP) is negative and significant. These results suggest that cooperative banks are able to issue high-quality loans, which makes the institutions more focused on lending activity more stable, in line with Köhler (2014) and Khan et al. (2017). Contrary

to the expectations, an increase in the share of customer deposits reduces cooperative banks' stability. According to prior literature, a bank stability can either benefit from the "stickiness" of customer deposits or be negatively affected by a lower market discipline and a lower flexibility in adapting to changes in the bank financing needs. Based on my result, the former effect is more than offset by the latter.

The coefficient of the proxy of bank size (SIZE) is significantly negative, which suggests that smaller cooperative banks are more stable compared to larger institutions. This finding is in line with Čihák and Hesse (2010) and Ashraf et al. (2016): according to these two papers, small Islamic banks are more stable than large Islamic banks. From the perspective of conventional banking, this result is also in line with Demirgüc-Kunt and Huizinga (2010), who find that larger banks exhibit lower risk aversion over the period 1995-2007, Maudos and De Guevara (2011), according to which EU, American, and Japanese banks show a negative, but not linear, relationship with stability over the years 2001-2008.

To conclude, I summarize the results of the country controls. Banking sector concentration (CONC) is significantly negative in affecting the financial stability of cooperative banks, in line with what found for non-cooperative institutions by Uhde and Heimeshoff (2009), Köhler (2014) and Chiaramonte and Casu (2017). Consistenly with expectations, the annual real GDP growth rate (GDPGR) is positively and significantly related with cooperative banks' stability, confirming that a higher rate of GDP growth is associated with a more stable macroeconomic environment and a relatively lower likelihood of bank failure and distress (Betz et al., 2014; Köhler, 2014; Khan et al., 2017; Chiaramonte and Casu, 2017).

In addition, I re-estimate my baseline model for the two sub-periods 2011-2014 and 2015-2018 in column 2 and 3 of Table 5 to investigate the potential differences in the relation NSFR-Z-score. In both the specifications results are confirmed in the signs of the coefficients, even if their size is generally greater during the years of negative interest rates. During the years of negative interest rates the downward-concave parabola relation between NSFR and cooperative banks' stability becomes more pronounced. This seems to suggest that the effect of the NSFR on stability turns negative at a lower level of the new liquidity standard, probably because a better structural liquidity position (higher NSFR) exacerbates the margins compression caused by the low level of market interest rates observed during those years. As far as the impact of the activity of collecting deposits and issuing loans to customers, I observe a different contribution of loans and deposits to bank stability in the two sub-periods, not in terms of the signs of their relations, but with regard to their strength, which becomes lower during the years 2015-2018.

[Insert Table 5 here]

Finally, to shed more light on the link between NSFR and Z-score, I study how the interaction of the NSFR with non-interest income, efficiency, credit risk and size affects banks' stability. In order to consider the interaction between pairs of covariates, Royston and Sauerbrei (2008) suggest the use of a multivariable fractional polynomials interaction (MFPI) technique, which is designed to investigate the interaction and statistical significance between each pair of covariates whether continuous, binary or categorical. I employ Royston and Sauerbrei (2012) to incorporate the impact of the interaction between the NSFR and the other covariates I am interested in and consequently re-estimate the empirical model by adding the interaction terms as shown in Table 6. The coefficient of the interaction term NSFR*NII is negative and significant, suggesting that the marginal impact of the NSFR on cooperative banks' stability decreases when the income diversification increases, i.e. as the share of non-interest income over the total operating income raises relative to that of the net interest margin. The coefficient of the interaction term NSFR*EFF is positive and significant, which seems to highlight that the marginal effect of the NSFR on stability is larger for banks characterized by higher efficiency levels. The coefficient of the interaction term NSFR*SIZE is negative and significant, since the marginal impact of the NSFR on cooperative banks' stability diminishes as the size of the bank increases. Credit risk does not seem to affect the relation between the NSFR and stability: the coefficient of the interaction term NSFR*CR is negative, but not statistically significant.

[Insert Table 6 here]

6. Robustness tests

In order to check the robustness of the results, I perform some sensitivity analyses. Firstly, a comparative study restricted to each of the three countries is interesting, because Austria, Germany and Italy were differently affected by the recent episodes of crisis and an individual analysis allows to detect how their cooperative banks behaved. Table 7 shows that the downward-concave parabola relation between the NSFR and stability is confirmed for Austrian and German cooperative banks, but not for Italian ones, that show a regression coefficient of the NSFR variable much lower than the rest of the sample.

[Insert Table 7 here]

Secondly, within the NSFR calculation I change the weighting factors applied to loans and deposits to test if the results are driven by the assumptions adopted in the baseline model to treat the two most important items of a cooperative bank's balance-sheet. I stress the NSFR measure by applying the lowest (highest) value in the range of the regulatory weights for all kinds of loans and the highest (lowest) value in the range of the regulatory weights for all kinds of deposits. In particular, in specification (1) of Table 8 I apply the 0.65 weighting coefficient for loans and the 0.90 weighting coefficient for deposits, whereas in specification (2) I use the 1 weighting coefficient for loans and the 0.50 weighting coefficient for deposits. The coefficients of the NSFR and $NSFR^2$ are statistically positive and negative, respectively, thus endorsing the main results.

[Insert Table 8 here]

Finally, in order to check if the relation between the NSFR and stability depends on the bank size, stability or liquidity position in terms of funding gap (i.e. the ratio of the difference between loans and deposits to loans), I split the overall sample in two sub-samples including banks belonging to the first 1st quartile and to the last quartile of the distribution of the total assets, Z-score and funding gap, respectively. Table 9 provides support to main previous findings: irrespective of size, stability and liquidity position of my sample banks, the non-linear relation between the NSFR and stability is confirmed.

[Insert Table 9 here]

7. Conclusions

In the aftermath of the GFC, through the Basel III accord, the BCBS introduced new changes in the banking regulatory framework and proposed a new requirement to cover funding liquidity risk, namely the NSFR. This paper analyses how cooperative banks' stability has reacted to the introduction of this new standard. The results extend two streams of literature: the first is about the cooperative banks' risk-taking incentives, and the second refers to the impact of the Basel III framework on European banking sector. Within this latter, whether and how the new liquidity requirements affect cooperative banks has not yet been investigated.

Based on a panel dataset of 1,173 cooperative banks from Austria, Germany and Italy, observed over the years 2011-2018, I empirically test the impact of the NSFR on the Z-score, a proxy for bank stability. Main findings suggest that stability improves for cooperative banks that have higher NSFRs,

but there is a point at which increasing further the NSFR diminishes their stability. In other words, the research adds to prior evidence referred to commercial banks and indicates that, to some extent, a higher NSFR allows to increase the financial stability of cooperative banks by reducing the maturity mismatch of their assets and liabilities.

Analysing the effect of the NSFR on cooperative banks' stability is of special interest to several stakeholders, such as customers-members and local community, due to the support that cooperative banks grant to SMEs and private citizens, by offering competitive banking products adjusted to better account for local conditions. Futhermore, I add evidence to prior research investigating whether and to what extent banks' stability changes in response to the NSFR introduction, which is a relevant issue from both bank managers' and regulators' perspective. Based on this study, an in-depth understanding of the impact of the NSFR on stability can help banking regulators and supervisors to improve the regulatory framework, to better discipline and control manager behaviour and to enhance bank resilience. The evidence about the non-linear relationship between the NSFR and cooperative banks' stability is particularly relevant for policymakers in devising new standards establishing an appropriate level of liquidity for banks.

Specifically accounting for the impact of the ECB's targeted long term refinancing operations (TLTRO) on banks' funding structure would be a worthwhile direction for future research on this topic. By changing the funding mix, TLTROs affect banks overall funding liquidity position and presumably its relation with stability.

Tables

Table 1. NSFR weighting factors

RSF			ASF		
Assets	**Factor**		**Liabilities**	**Factor**	
	Basel	**Applied**		**Basel**	**Applied**
Residential mortgage loans	0.65-1	0.65	Customer deposits - current	0.5-0.9	0.85
Other mortgage loans	0.65-1	0.65	Customer deposits - savings	0.5-0.9	0.8
Other consumer/retail loans	0.65-1	0.85	Customer deposits - term	0.5-0.9	0.8
Corporate and commercial loans	0.65-1	0.85	**Total customer deposits**		
Other loans	0.65-1	0.85			
			Deposits from banks	0-0.5	0
Less: Reserves for impaired loans/NPLs		-1	Repos and cash collateral	0-0.5	0
Net loans			Other deposits and short-term borrowings	0-0.5	0
			Total deposits, money market and short-term fund		
Gross loans					
Loans and advances to banks	0-1	0.35	Senior debt maturing after 1 year	1	1
Reverse repos and cash collateral	0	0	Subordinated borrowing	1	1
Trading securities and at fair value through income	0.05-1	0.35	Other funding	-	1
Derivatives		0.25	**Total long term funding**		
Available for sale securities	0.05-1	0.35			
Held to maturity securities	0.05-1	1	Derivatives	0	0
At-equity investments in associates	0.05-1	1	Trading liabilities	0	0
Other securities	0.05-1	1	**Total funding**		
Total securities					
			Reserves for pensions and other	1	1
Investments in property	1	1	Other non interest	1	0
Insurance assets	1	1	**Total liabilities**		
Other earning assets	1	1			
Total earning assets			Pref. shares and hybrid capital accounted for as debt	1	1
			Pref. shares and hybrid capital accounted for as equity	1	1
Cash and due from banks	0	0	Non-controlling interest	-	-
Residual assets	-	1	Total equity	1	1
Total assets			Total liabilities and equity	-	-
			Central bank refinancing (3 years)	1	1
Liabilities					
Guarantees	0.05	0.05			
Committed credit lines	0.05	0.05			
Other contingent liabilities	0.05	0.05			

Source: Scalia et al. (2013)

Table 2. Description of variables

Variables	Description	Pred.coeff	Source
Dependent variable			
Z-score	The natural logarithm of Z-score $Zscore_{it}=(ROA_{it}+CAR_{it})/\sigma(ROA)_{ip}$	/	Moody's Analytics BankFocus and author computation
Bank-specific variables			
NSFR	Net Stable Funding Ratio, a measure for funding liquidity risk	(+)	Moody's Analytics BankFocus and author computation
NII	Non-interest income to operating income	(+)	Moody's Analytics BankFocus
EFF	Operating income to total operating expenses	(+)	Moody's Analytics BankFocus
CR	Loan loss provisions to customer loans	(-)	Moody's Analytics BankFocus
LOAN	Customer loans to total assets	(+/-)	Moody's Analytics BankFocus
DEP	Customer deposits to total assets	(+/-)	Moody's Analytics BankFocus
SIZE	The natural logarithm of total assets	(+/-)	Moody's Analytics BankFocus and author computation
Country-specific variables			

CONC	Herfindahl-Hirschman index (higher values imply a less competitive environment)	(-)	Moody's Analytics BankFocus and author computation
GDPGR	Annual real GDP growth rate	(+)	World Bank

This table presents description, predicted coefficients, and source of the dependent variable, bank-specific and country-specific variables.

Table 3. Descriptive statistics

Variables	Obs	Mean	Std. Dev.	Median	Min	Max
Dependent variable						
Z-score (1)	7,531	4.8325	4.6873	0.9711	2.2552	8.2831
Bank-specific variables						
NSFR	7,531	102.5203	17.1428	98.4306	66.9471	162.6353
NII	7,531	33.3723	9.9475	32.2239	-8.9503	108.0499
EFF	7,531	148.4416	37.9907	144.1917	78.6091	1554.8410
CR	7,531	0.2435	0.7392	0.1535	-5.9550	5.8941
LOAN	7,531	60.6765	12.9256	61.4286	16.2816	96.5345
DEP	7,531	73.5262	12.0484	76.5600	12.2216	94.2093
SIZE (1)	7,531	19.6165	1.1186	19.5441	17.3311	23.0242
Country-specific variables						
CONC	7,531	18.4576	9.3896	15.0711	8.1958	50.9898
GDPGR	7,531	1.3848	1.1528	1.7162	-2.9809	3.9241

This table presents the descriptive statistics of the dependent, bank-specific and country-specific variables in percentage points unless otherwise stated. (1) In nominal value. Table 2 gives the definitions of the variables.

Table 4. Pair-wise correlation coefficients

	Z-score	NSFR	NII	EFF	CR	LOAN	DEP	SIZE	CONC	GDPGR
Z-score	1.0000									
NSFR	-0.3106***	1.0000								
NII	-0.0753***	0.0754***	1.0000							
EFF	-0.0384***	0.0314***	0.0076	1.0000						
CR	-0.2271***	0.3537***	0.1676***	0.2317***	1.0000					
LOAN	-0.0890***	-0.1997***	-0.1910***	-0.1034***	-0.0440***	1.0000				
DEP	0.1857***	-0.1150***	-0.0360***	-0.2443***	-0.4435***	-0.2329***	1.0000			
SIZE	0.1842***	-0.1690***	0.1255***	0.2537***	0.1197***	0.0529***	-0.2487***	1.0000		
CONC	-0.1656***	-0.0862***	0.0948***	-0.1686***	-0.1609***	-0.0319***	0.3441***	-0.3122***	1.0000	
GDPGR	0.2162***	-0.3274***	0.0410***	-0.1573***	-0.3461***	-0.0276**	0.4547***	-0.0045	0.1497***	1.0000

Notes: ***, ** and * are statistical significances at 0.01, 0.05 and 0.10 level, respectively. Table 2 gives the definitions of the variables.

Table 5. The NSFR and cooperative banks' stability

Variables	(1) Z-score	(2) Z-score	(3) Z-score
NSFR	2.7113***	1.4683***	2.0530***
	(0.1144)	(0.2198)	(0.1514)
$NSFR^2$	-0.8126***	-0.3605***	-0.5651***
	(0.0512)	(0.0961)	(0.0649)
NII	0.3265***	0.1476***	0.2566***
	(0.0203)	(0.0344)	(0.0260)
EFF	0.0355***	0.0630***	0.0483***
	(0.0050)	(0.0071)	(0.0091)
CR	-1.6501***	-1.7153***	-1.8665***
	(0.1713)	(0.2312)	(0.2252)
LOAN	0.5055***	0.6293***	0.2665***
	(0.0211)	(0.0456)	(0.0278)
DEP	-0.6512***	-0.1628***	-0.5972***
	(0.0263)	(0.0495)	(0.0452)
SIZE	-0.0698***	-0.0478***	-0.1107***
	(0.0072)	(0.0177)	(0.0091)
CONC	-0.1911***	-0.1918***	0.1300
	(0.0165)	(0.0205)	(0.0978)
GDPGR	1.1383***	0.5589***	1.3592***
	(0.0987)	(0.1016)	(0.2132)
Constant	4.3335***	4.1984***	5.6628***
	(0.1484)	(0.3846)	(0.1875)
Bank FE	YES	YES	YES
Observations	7,531	3,037	4,494
R-squared	0.3673	0.3479	0.3221
Number of banks	1,173	1,098	1,166

Notes: The sample comprises annual data of 1,173 cooperative banks operating in Austria, Germany and Italy over the years 2011-2018. The estimations are based on Fixed Effect model. Standard errors are reported in parentheses. ***, ** and * are statistical significances at 0.01, 0.05 and 0.10 level, respectively. Table 2 gives the definitions of the variables. (1) Baseline regression estimates for the whole period. (2) Baseline regression estimates for the years 2011-2014. (3) Baseline regression estimates for the years 2015-2018.

Table 6. The NSFR and cooperative banks' stability: interacting liquidity with other main characteristics

	(1)	(2)	(3)	(4)
Variables	**Z-score**	**Z-score**	**Z-score**	**Z-score**
NSFR	2.7375***	2.5499***	2.7110***	4.2655***
	(0.1139)	(0.1248)	(0.1150)	(0.3331)
$NSFR^2$	-0.7269***	-0.8037***	-0.8124***	-0.8387***
	(0.0523)	(0.0513)	(0.0518)	(0.0514)
NII	1.0352***	0.3182***	0.3266***	0.3328***
	(0.0958)	(0.0205)	(0.0207)	(0.0203)
EFF	0.0384***	-0.0658**	0.0355***	0.0352***
	(0.0050)	(0.0318)	(0.0051)	(0.0050)
CR	-1.5280***	-1.7198***	-1.6296*	-1.6291***
	(0.1713)	(0.1726)	(0.9384)	(0.1711)
LOAN	0.4828***	0.5039***	0.5055***	0.5038***
	(0.0212)	(0.0211)	(0.0211)	(0.0210)
DEP	-0.6324***	-0.6444***	-0.6512***	-0.6471***
	(0.0263)	(0.0264)	(0.0264)	(0.0263)
SIZE	-0.0747***	-0.0683***	-0.0698***	0.0065
	(0.0072)	(0.0072)	(0.0073)	(0.0170)
CONC	-0.2053***	-0.1922***	-0.1911***	-0.1875***
	(0.0165)	(0.0165)	(0.0165)	(0.0165)
GDPGR	1.1857***	1.1471***	1.1381***	1.1462***
	(0.0985)	(0.0986)	(0.0988)	(0.0985)
NSFR*NII	-0.6545***			
	(0.0865)			
NSFR*EFF		0.0924***		
		(0.0286)		
NSFR*CR			-0.0197	
			(0.8880)	
NSFR*SIZE				-0.0763***
				(0.0154)
Constant	4.2956***	4.4696***	4.3339***	2.7986***
	(0.1479)	(0.1542)	(0.1496)	(0.3427)
Bank FE	YES	YES	YES	YES
Observations	7,531	7,531	7,531	7,531
R-squared	0.3730	0.3684	0.3673	0.3698
Number of banks	1,173	1,173	1,173	1,173

Notes: The sample comprises annual data of 1,173 cooperative banks operating in Austria, Germany and Italy over the years 2011-2018. The estimations are based on Fixed Effect model. Standard errors are reported in parentheses. ***, ** and * are statistical significances at 0.01, 0.05 and 0.10 level, respectively. Table 2 gives the definitions of the variables.

Table 7. The NSFR and cooperative banks' stability: focusing on Austria, Germany and Italy, separately

	(1)	(2)	(3)
Variables	**Z-score**	**Z-score**	**Z-score**
NSFR	3.2952***	5.9359***	0.9108***
	(0.2825)	(0.2610)	(0.2711)
$NSFR^2$	-1.1791***	-2.4702***	-0.1536
	(0.1211)	(0.1295)	(0.1094)
NII	0.1915***	0.3095***	0.2685***
	(0.0395)	(0.0284)	(0.0444)
EFF	0.0969***	0.0384***	0.0390***
	(0.0154)	(0.0088)	(0.0077)
CR	-5.2159***	-1.0910***	-3.5828***
	(0.3915)	(0.1753)	(0.5021)
LOAN	0.6045***	0.5164***	0.0813**
	(0.0517)	(0.0339)	(0.0397)
DEP	-0.5581***	-1.1614***	-0.2159***
	(0.1035)	(0.0662)	(0.0512)
SIZE	-0.1113***	0.0215**	-0.3942***
	(0.0120)	(0.0087)	(0.0212)
CONC	-0.1440***	-0.3139***	-1.1826***
	(0.0199)	(0.0265)	(0.2562)
GDPGR	0.4961***	2.2961***	-0.6023***
	(0.1580)	(0.1397)	(0.2041)
Constant	4.0614***	1.9839***	11.1890***
	(0.2730)	(0.1919)	(0.4900)
Bank FE	YES	YES	YES
Observations	1,861	4,251	1,419
R-squared	0.4513	0.5155	0.4732
Number of banks	277	694	202

Notes: The sample comprises annual data of 1,173 cooperative banks operating in Austria, Germany and Italy over the years 2011-2018. The estimations are based on Fixed Effect model. Standard errors are reported in parentheses. ***, ** and * are statistical significances at 0.01, 0.05 and 0.10 level, respectively. Table 2 gives the definitions of the variables. (1) Austria; (2) Germany; (3) Italy.

Table 8. The NSFR and cooperative banks' stability: different NSFR calculation methods

	(1)	(2)
Variables	**Z-score**	**Z-score**
NSFR	2.2100***	3.4606***
	(0.0806)	(0.1234)
$NSFR^2$	-0.5547***	-1.4209***
	(0.0274)	(0.0809)
NII	0.3515***	0.3069***
	(0.0209)	(0.0192)
EFF	0.0349***	0.0358***
	(0.0052)	(0.0048)
CR	-1.6571***	-1.5918***
	(0.1769)	(0.1623)
LOAN	0.2719***	0.6219***
	(0.0208)	(0.0200)
DEP	-0.6754***	-0.3206***
	(0.0287)	(0.0246)
SIZE	-0.0774***	-0.0521***
	(0.0074)	(0.0069)
CONC	-0.2211***	-0.1740***
	(0.0170)	(0.0156)
GDPGR	1.1571***	1.1537***
	(0.1017)	(0.0931)
Constant	4.6310***	3.9621***
	(0.1518)	(0.1379)
Bank FE	YES	YES
Observations	7,531	7,531
R-squared	0.3257	0.4349
Number of banks	1,173	1,173

Notes: The sample comprises annual data of 1,173 cooperative banks operating in Austria, Germany and Italy over the years 2011-2018. The estimations are based on Fixed Effect model. Standard errors are reported in parentheses. ***, ** and * are statistical significances at 0.01, 0.05 and 0.10 level, respectively. Table 2 gives the definitions of the variables. (1) The NSFR is calculated by applying the 0.65 weighting coefficient for loans and the 0.90 weighting coefficient for deposits. (2) The NSFR is calculated by applying the 1 weighting coefficient for loans and the 0.50 weighting coefficient for deposits.

Table 9. The NSFR and cooperative banks' stability: small vs. large banks, based on the total assets (TA) distribution; less stable vs. more stable banks, based on the Z-score (ZS) distribution; less liquid banks vs. more liquid banks, based on the funding gap (FG) distribution

	Z-score		Z-score		Z-score	
Variables	**25th perc. of TA**	**75th perc. of TA**	**25th perc. of ZS**	**75th perc. of ZS**	**25th perc. of FG**	**75th perc. of FG**
NSFR	4.6881***	3.0927***	2.4096***	6.0202***	7.1168***	2.1242***
	(0.2593)	(0.2918)	(0.2542)	(0.3675)	(0.3933)	(0.2258)
NSFR2	-2.4395***	-1.1630***	-0.8215***	-3.4378***	-3.8931***	-0.6349***
	(0.1701)	(0.2020)	(0.1639)	(0.2804)	(0.2759)	(0.1436)
NII	0.3231***	0.2560***	0.2686***	0.2797***	0.1227***	0.2084***
	(0.0343)	(0.0386)	(0.0396)	(0.0380)	(0.0380)	(0.0412)
EFF	0.0931***	0.0290***	0.0707***	0.0383**	0.0264***	0.0897***
	(0.0132)	(0.0061)	(0.0117)	(0.0153)	(0.0054)	(0.0138)
CR	-1.8042***	-2.4926***	-3.4131***	-0.5510**	-0.6085**	-3.6817***
	(0.2589)	(0.4205)	(0.3731)	(0.2541)	(0.2366)	(0.4355)
LOAN	0.5677***	0.7287***	0.4492***	0.6932***	0.8676***	0.4142***
	(0.0355)	(0.0445)	(0.0422)	(0.0446)	(0.0605)	(0.0429)
DEP	-0.5963***	-0.5238***	-0.2267***	-0.7551***	-1.0421***	-0.0496
	(0.0496)	(0.0541)	(0.0500)	(0.0753)	(0.0972)	(0.0439)
SIZE	-0.2085***	0.0170	-0.0784***	0.0195	-0.0311*	-0.1318***
	(0.0179)	(0.0142)	(0.0155)	(0.0145)	(0.0161)	(0.0158)
CONC	-0.2080***	-0.3395***	-0.2876***	-0.2319***	-0.1349***	-0.3300***
	(0.0219)	(0.0445)	(0.0329)	(0.0360)	(0.0260)	(0.0488)
GDPGR	0.9908***	1.4682***	0.9297***	2.2179***	1.3844***	0.3427*
	(0.1553)	(0.2068)	(0.1978)	(0.1905)	(0.1889)	(0.1768)
Constant	6.3540***	3.0592***	3.7316***	3.4762***	3.0255***	5.6876***
	(0.3337)	(0.3006)	(0.3246)	(0.2845)	(0.3206)	(0.3339)
Bank FE	YES	YES	YES	YES	YES	YES
Observations	1,873	1,883	1,882	1,882	1,882	1,882
R-squared	0.4457	0.4584	0.4010	0.5848	0.4782	0.4570
Number of banks	342	353	343	328	414	402

Notes: The sample comprises annual data of 1,173 cooperative banks operating in Austria, Germany and Italy over the years 2011-2018. The estimations are based on Fixed Effect model. Standard errors are reported in parentheses. ***, ** and * are statistical significances at 0.01, 0.05 and 0.10 level, respectively. Table 2 gives the definitions of the variables.

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